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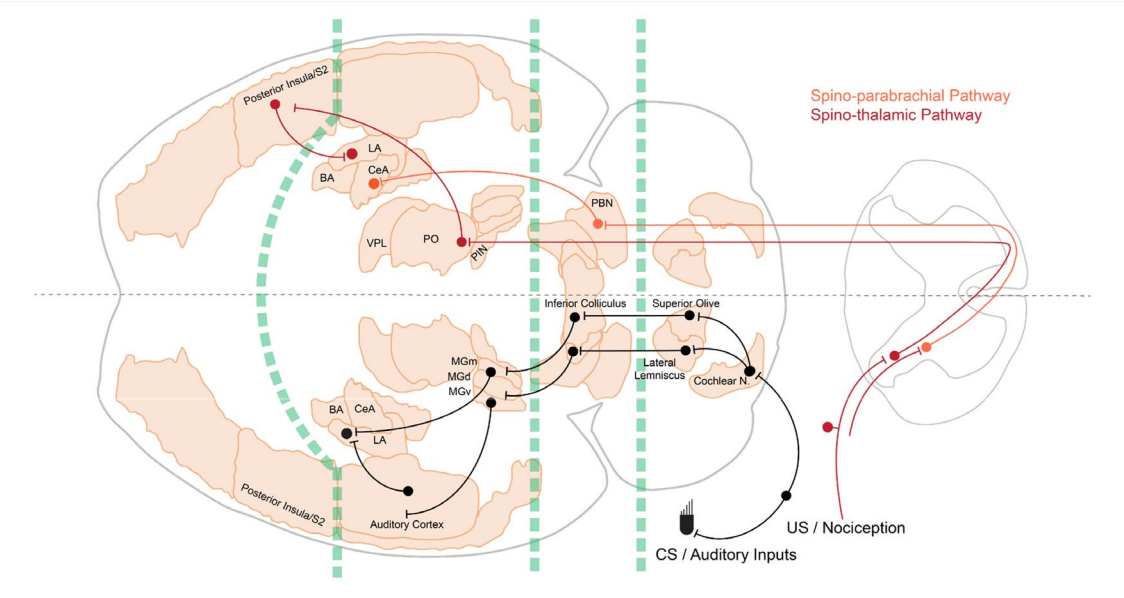
Unit 5 – Learned fear, part2

1) Read and discuss the following paper:

Tovote, P., Esposito, M., Lüthi, A. et al. **Midbrain circuits for defensive behaviour.** Nature 534, 206–212 (2016). https://doi.org/10.1038/nature17996 (on moodle)

Please be prepared to show and Discuss ALL main Figures (Figure 1-5)
PLUS Extended Data Figure 2, 4 and 5.

2) The following scheme shows the ascending information about nociception (US, red) and about tones (CS, black).



a) Review the ascending pathway for nociceptive information.
b) Review the ascending pathway for auditory information.
c) name all synaptic waystations in-between the sensory neuron / sensory cell, up to the arrival to the amygdala.
d) If you were to compare the lateral amygdala to other brain areas related to sensory processing, to "what kind of level" would you compare the LA:
    A. comparable to a brainstem nucleus / spinal cord area
    B. comparable to a thalamic nucleus
    C. comparable to a primary sensory cortical area
    D. comparable to an associative cortical area

3) Explain how the association of CS- and US-information in the lateral amygdala (LA), and ensuing plasticity in LA principal neurons, is thought to cause auditory-cued fear learning. Use the terms *glutamate synapse*, *afferent information*, *MGm*, *CS*, *US*, *long-term potentiation (LTP*), *NMDA-receptor*, *AMPA-receptor*, and *two-factor rule* in your explanation.

4) Give a general explanation how the neuromodulators Noradrenaline, and Dopamine, could facilitate the formation of an auditory-cued fear memory.

5) Considering the connection from the basal amygdala (BA) to the Nucleus Accumbens (NAc) described by Stuber et al. 2011. This connection is part of a larger system discussed in Unit 1, please name it.

6) Which two populations of excitatory neurons in the basal amygdala (BA) process stimuli of positive-, and negative valence. Explain how these neuronal populations were discovered in optogenetic- and behavioral experiments with mice.

7) Explain the role of the central amygdala (CeA) in fear learning. Which transmitter do principal neurons in the CeA use, and which three sub-divisions of the CeA can be distinguished? From where does the CeA receive its input during fear learning?